

A Rational Explanation of Hidden Price

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An example of hidden price

StubHub:

1. Towards the start of the user's journey on stubhub.com, they are shown a price.

112

Row Y

You'll pay

\$310 each

Quantity

1 ticket



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2. The user proceeds through multiple steps in which they must enter their name, phone number, email and postal address. Only then are they shown the total price. In this case it is a 29% increase.

Ticket Price

1 × US\$ 310.05

Service Fee

1 × US\$ 86.13

Fulfillment Fee

1 × US\$ 4.95

TOTAL PRICE

US\$ 401.13

Hidden price is impactful

- Blake et. al (2021): hidden price leads to
 - 21% more money spent
 - 14% higher purchase likelihood

Current explanation of hidden price

- Avoidable add-ons rather than unavoidable charges: Gabaix and Laibson (2006)
- Salience: Bordalo et al. (2013), Inderst and Obradovits (2023)
- Miscalculation of taxes: Chetty et al. (2009)

The above papers assume some kind of **behavioral bias**

- Unawareness of the fee softens price competition: Heidhues et al. (2021)

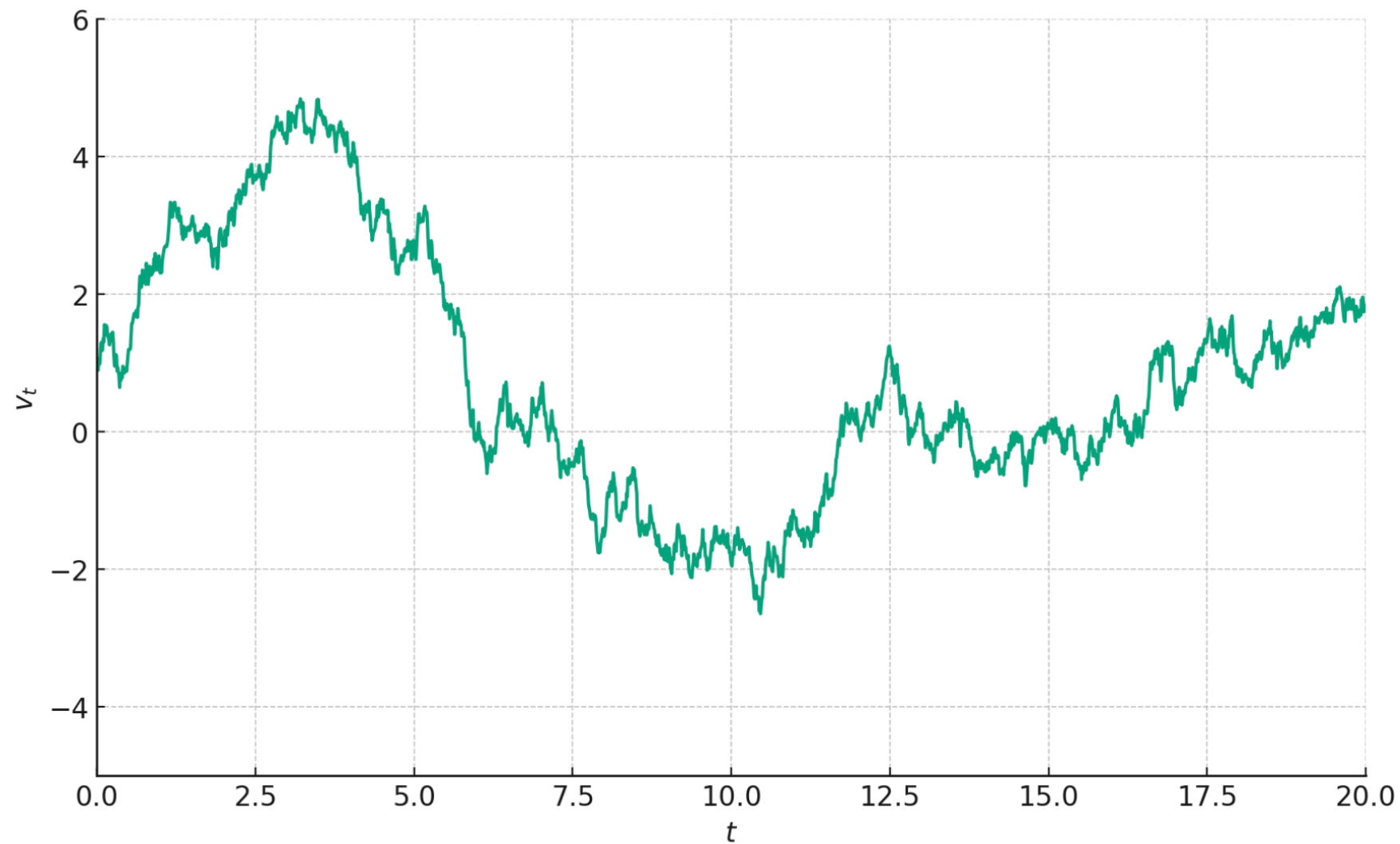
This paper

- A rational explanation without assuming any behavioral bias
- Taking into account **consumer search**

Basic consumer search model (Branco et al. 2012)

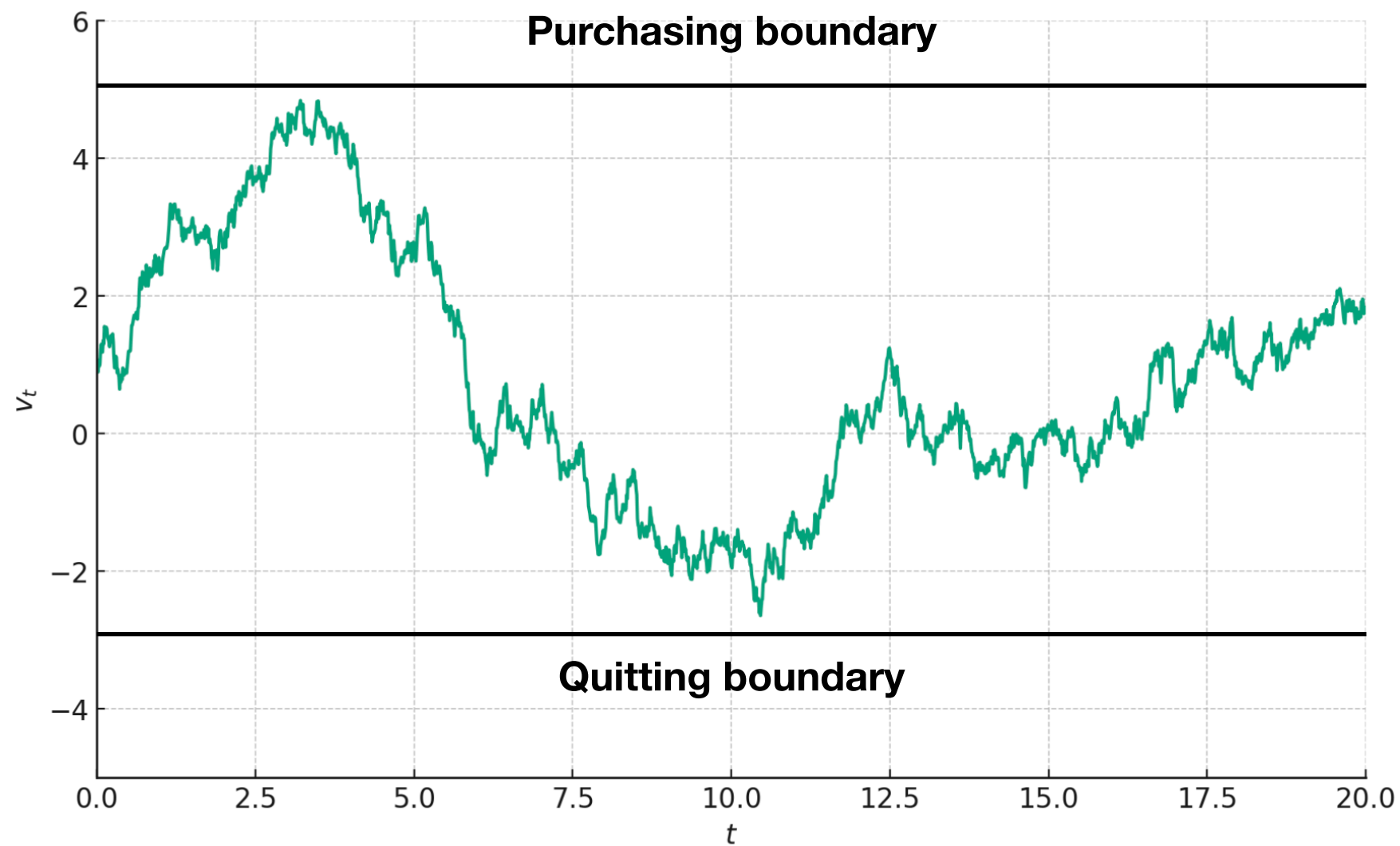
- A firm offers a product with a marginal cost of m and price p
- A consumer decides whether to buy it
- The consumer can search for information before making a decision
 - initial valuation: v_0 (common knowledge)
 - search cost: $c dt$ per dt time
 - consumer's valuation: $dv_t = \sigma dW_t$ (a Brownian motion)
- No discounting

Sample path of the consumer's learning processes



$$v_0 = 1$$

Consumer's search strategy



$$v_0 = 1, p = 1$$

Consumer search can benefit the firm

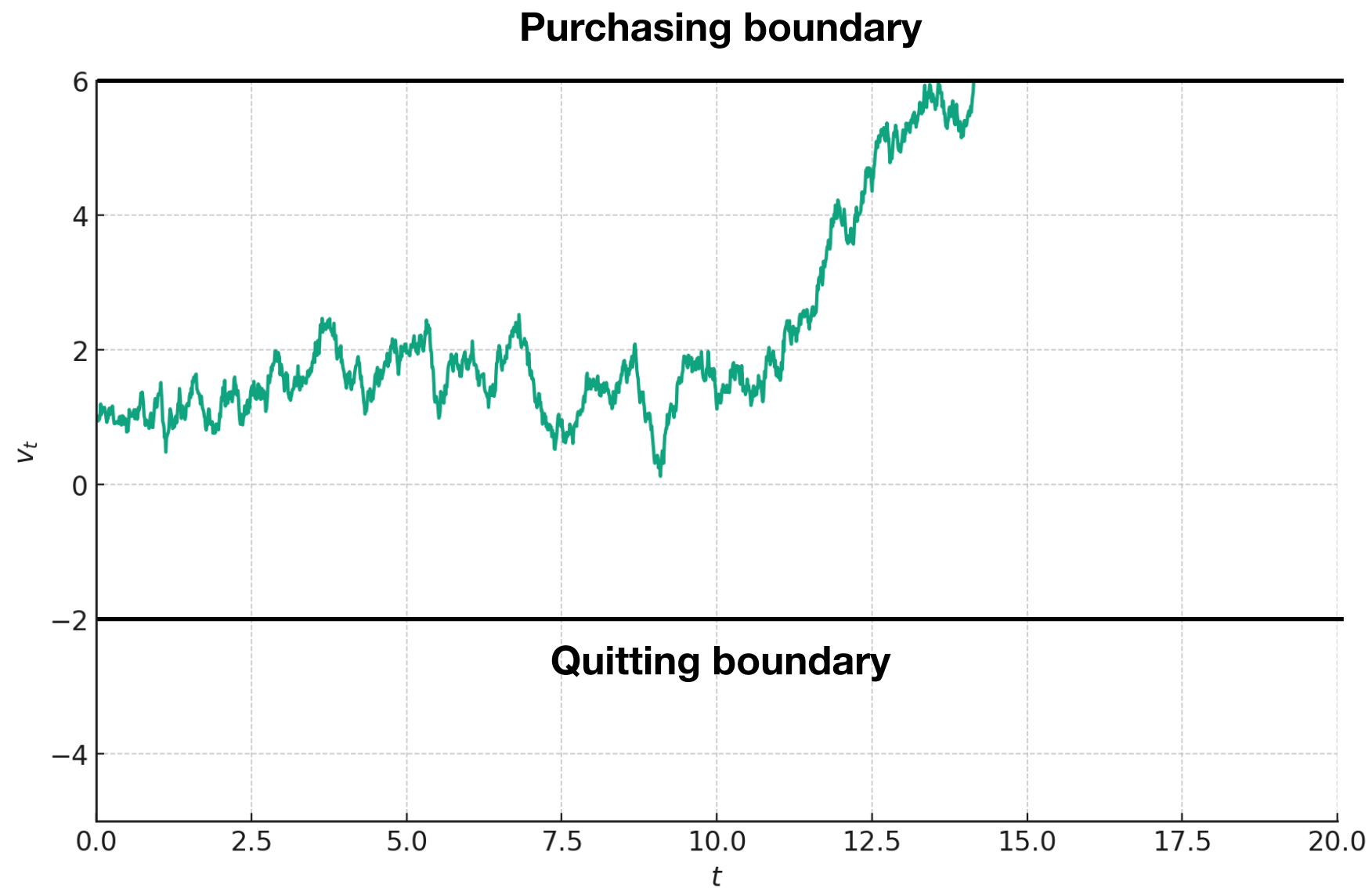
- When search is not feasible, the firm can charge at most v_0

The firm will not sell any product if the initial valuation is lower than the marginal cost, $v_0 < m$

- When search is feasible, the firm can charge a higher price

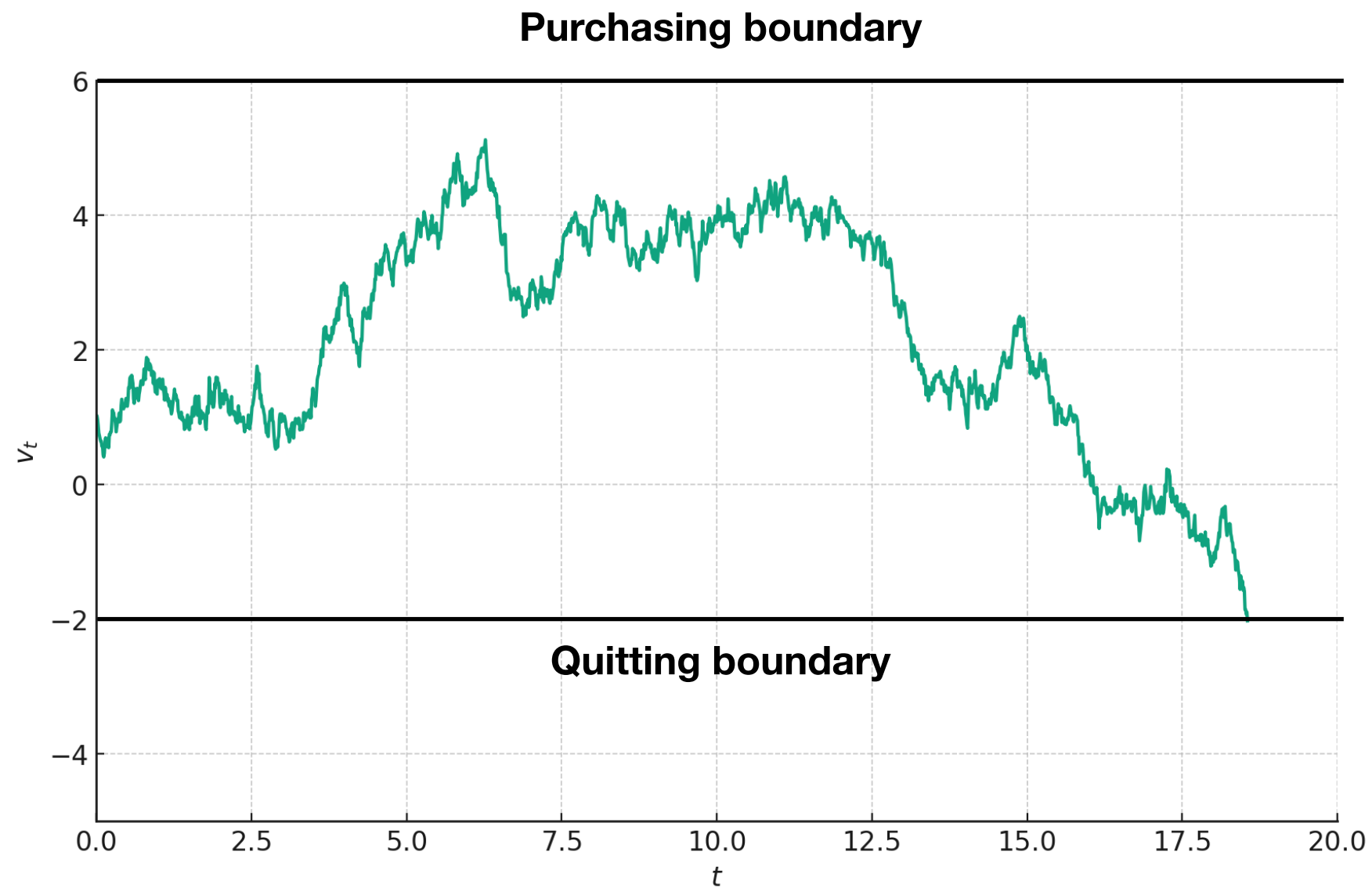
The firm can make positive profits even if $v_0 < m$

Purchase



$$v_0 = 1, m = 1.5, p = 2$$

No purchase



$$v_0 = 1, m = 1.5, p = 2$$

+ Hidden price

- The same setup as before, except that:
- When the consumer's valuation v_t reaches the purchasing threshold, the consumer
 - ▶ decides to buy and go to the checkout page
 - ▶ will see an additional hidden price Δp
 - ▶ will not buy the product **without behavioral bias** (the hidden price raises the purchasing threshold)
 - ▶ faces an updated search problem

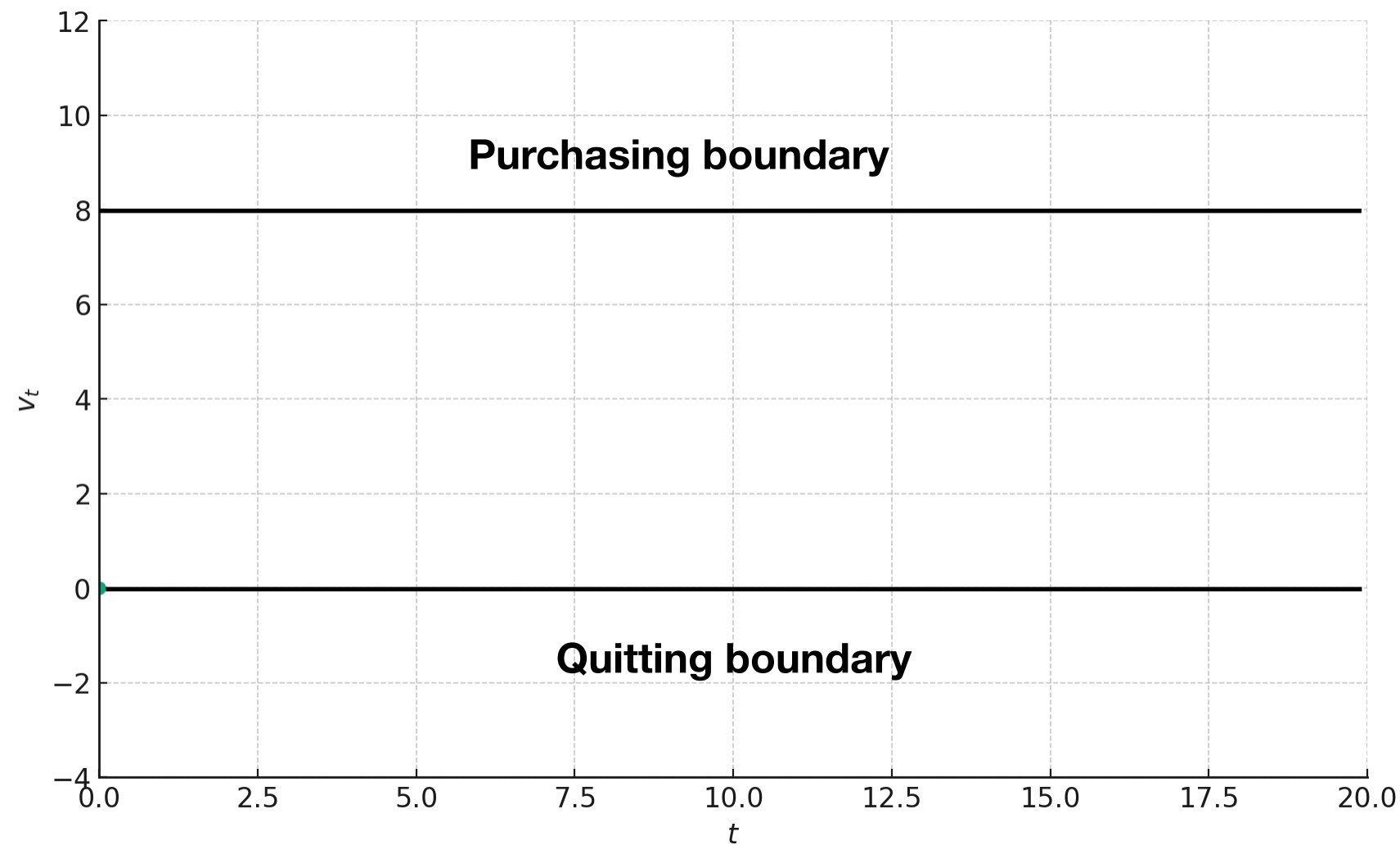
Hidden price can benefit the firm

- When hidden price is not feasible, the firm cannot sell any product if $v_0 < -\sigma^2/4c + m$
- When hidden price is feasible, the firm can induce the consumer to search in a wider range by offering a lower price initially

The firm can make positive profits even if $v_0 < -\sigma^2/4c + m$

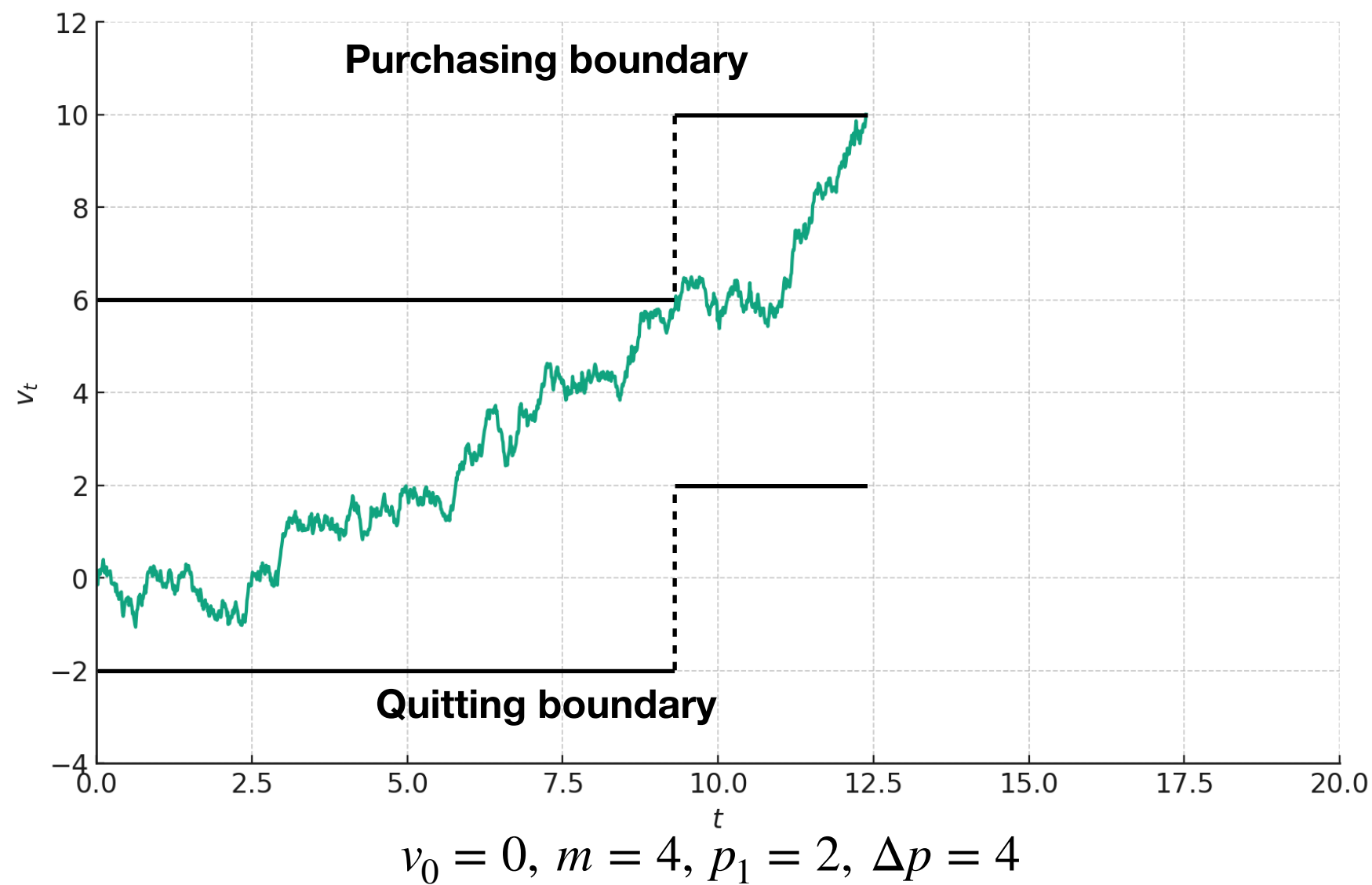
Parameter range: $\max\{-\sigma^2/4c, -3\sigma^2/4c + m\} < v_0 \leq -\sigma^2/4c + m$

Neither search nor purchase without a hidden price



$$v_0 = 0, m = 4, p = 4$$

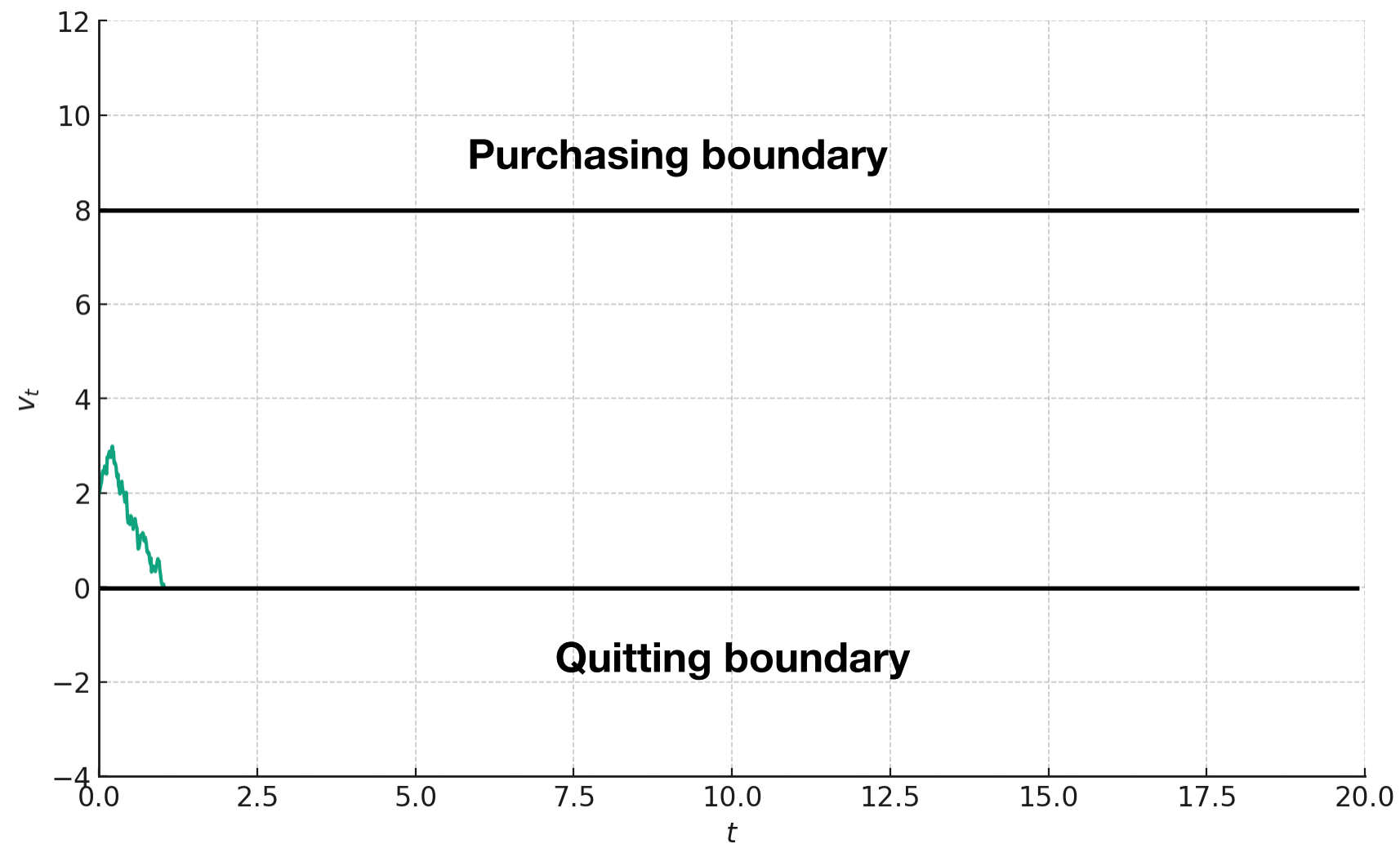
Positive expected profit with hidden price



Hidden price can benefit the firm

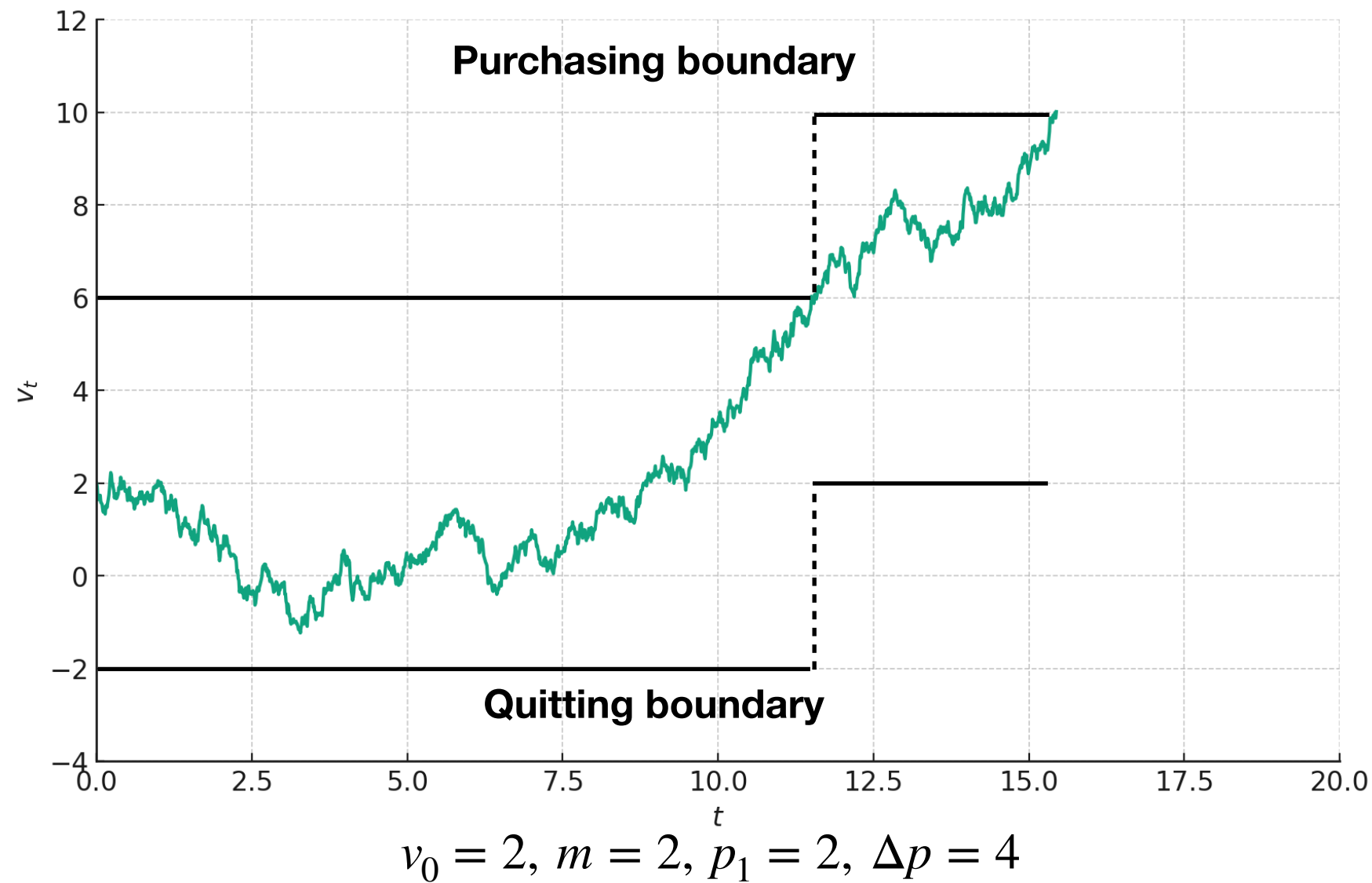
- Even if the firm can earn a positive profit without hidden price when $v_0 > -\sigma^2/4c + m$, it can increase the profit by using hidden price
- Parameter range: $-\sigma^2/4c + m < v_0 < 3\sigma^2/4c + m$

Quick exit after searching without hidden price

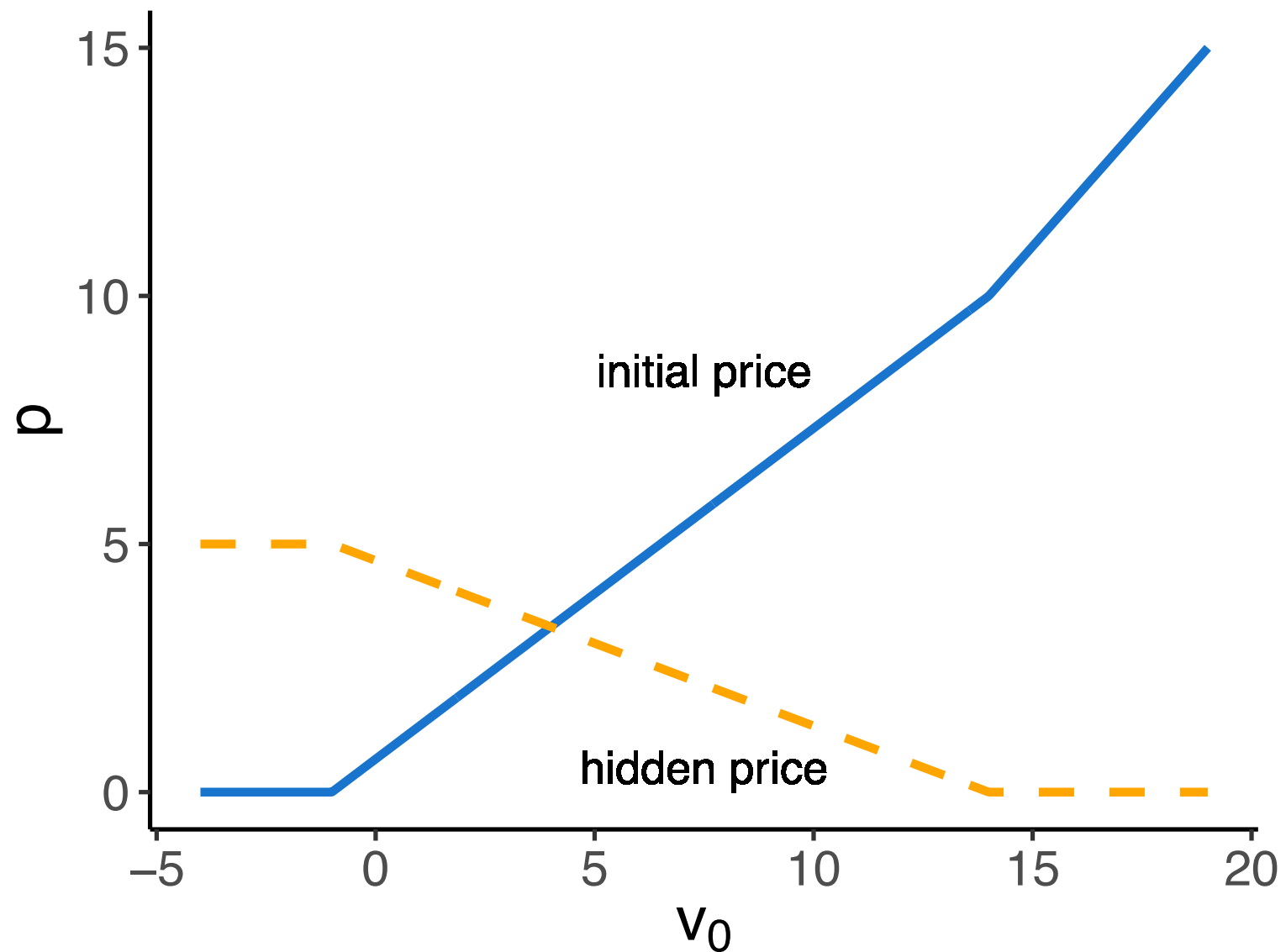


$$v_0 = 2, m = 2, p = 4$$

Purchase after searching with hidden price



Optimal Price with hidden price



$$m = 2, \sigma = 0.4, c = 0.01$$

Comparative statics of the optimal price with hidden price

- The hidden price Δp increases in the signal informativeness σ^2 , the marginal cost m , and decreases in the search cost c , the initial valuation v_0
- The initial price p increases in v_0 and m (it does not depend on σ^2 and c)
- The total price $p + \Delta p$ increases in v_0 , σ^2 , m , and decreases in c

Expected search time under the optimal price with hidden price

- Relatively high initial valuation v_0

Search time in the first stage = search time in the second stage

The firm perfectly smooths consumers' search behavior

- Intuition:

Initial price too high \Rightarrow quitting boundary is close to $v_0 \Rightarrow$ quick exit if the consumer gathers a few negative signals early on **✗**

Initial price too low \Rightarrow purchasing boundary is close to $v_0 \Rightarrow$ the consumer will go to the checkout stage with a high probability \Rightarrow a high hidden price \Rightarrow quitting boundary is close to her valuation \Rightarrow quick exit **✗**

The optimal price balances the consumer's search behavior

Expected search time under the optimal price with hidden price

- Relatively low initial valuation v_0

Search time in the first stage < search time in the second stage

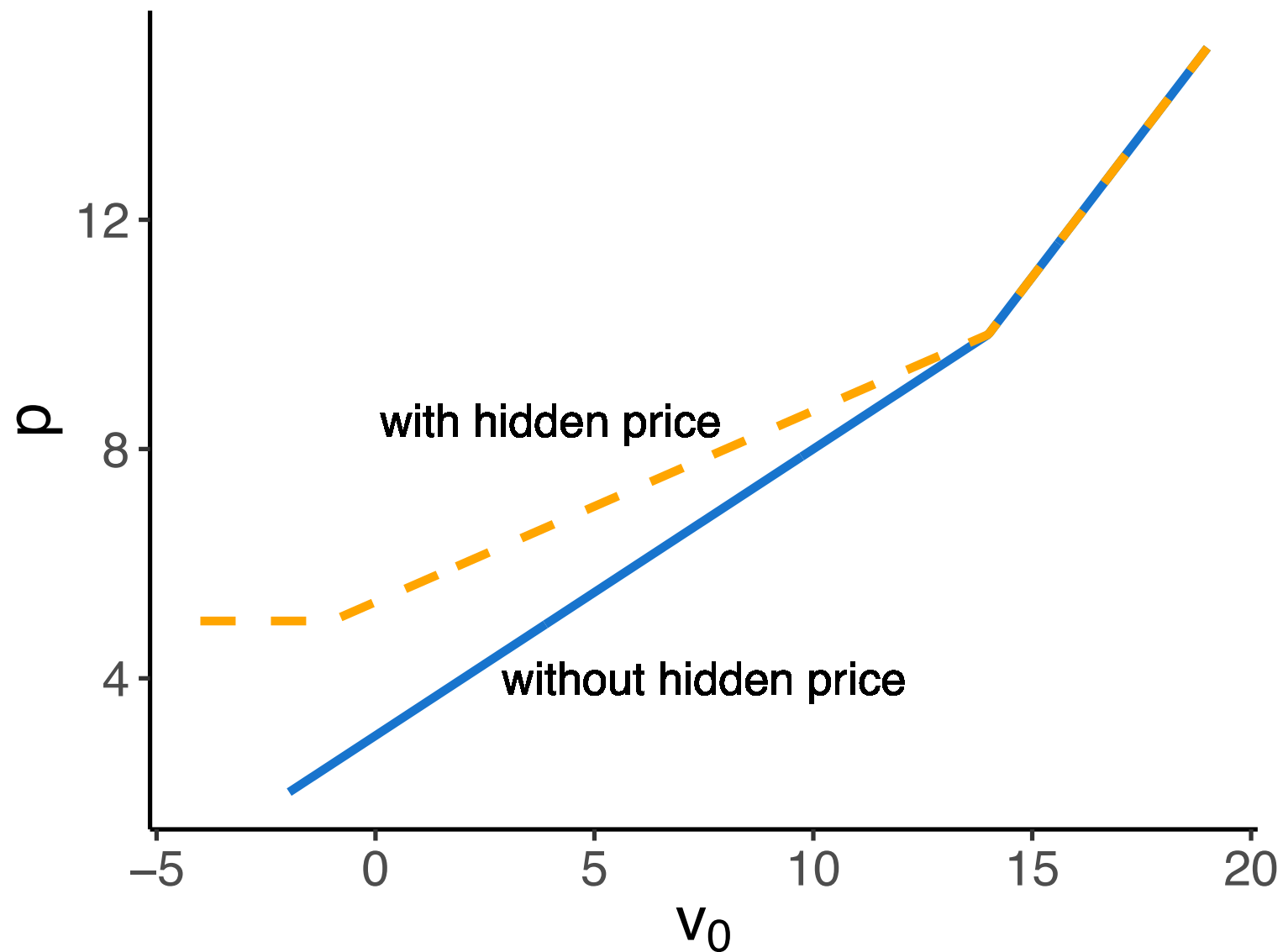
- Intuition:

low $v_0 \Rightarrow$ quitting boundary is close to v_0 even with a low initial price
 \Rightarrow quick exit if the consumer gathers a few negative signals

if the consumer reaches the checkout page \Rightarrow a much higher valuation \Rightarrow willing to keep searching even if she receives some negative signals at the second stage.

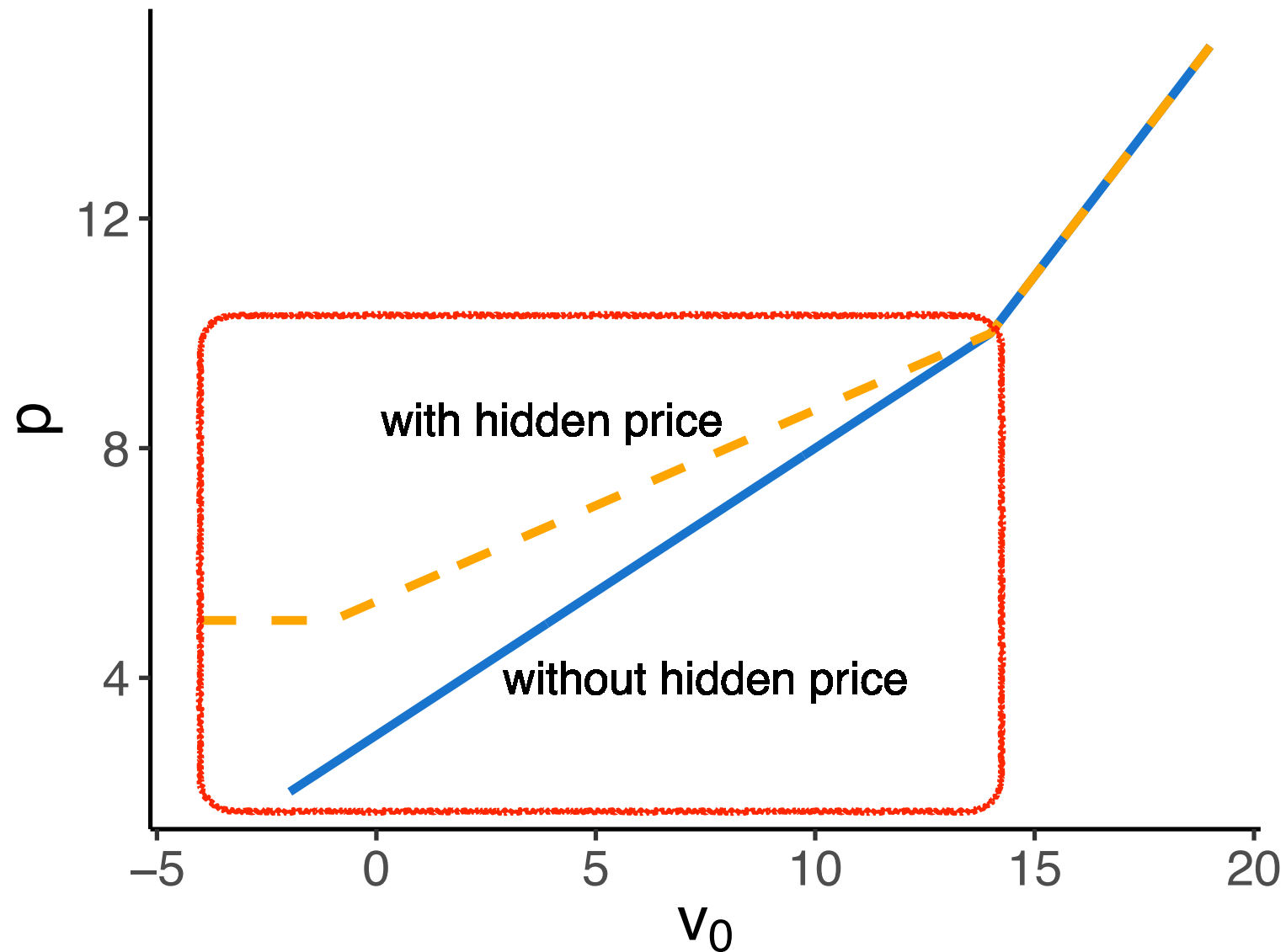
The low initial valuation makes it impossible for the firm to perfectly smooth the consumer's search behavior.

Optimal Price with and without hidden price



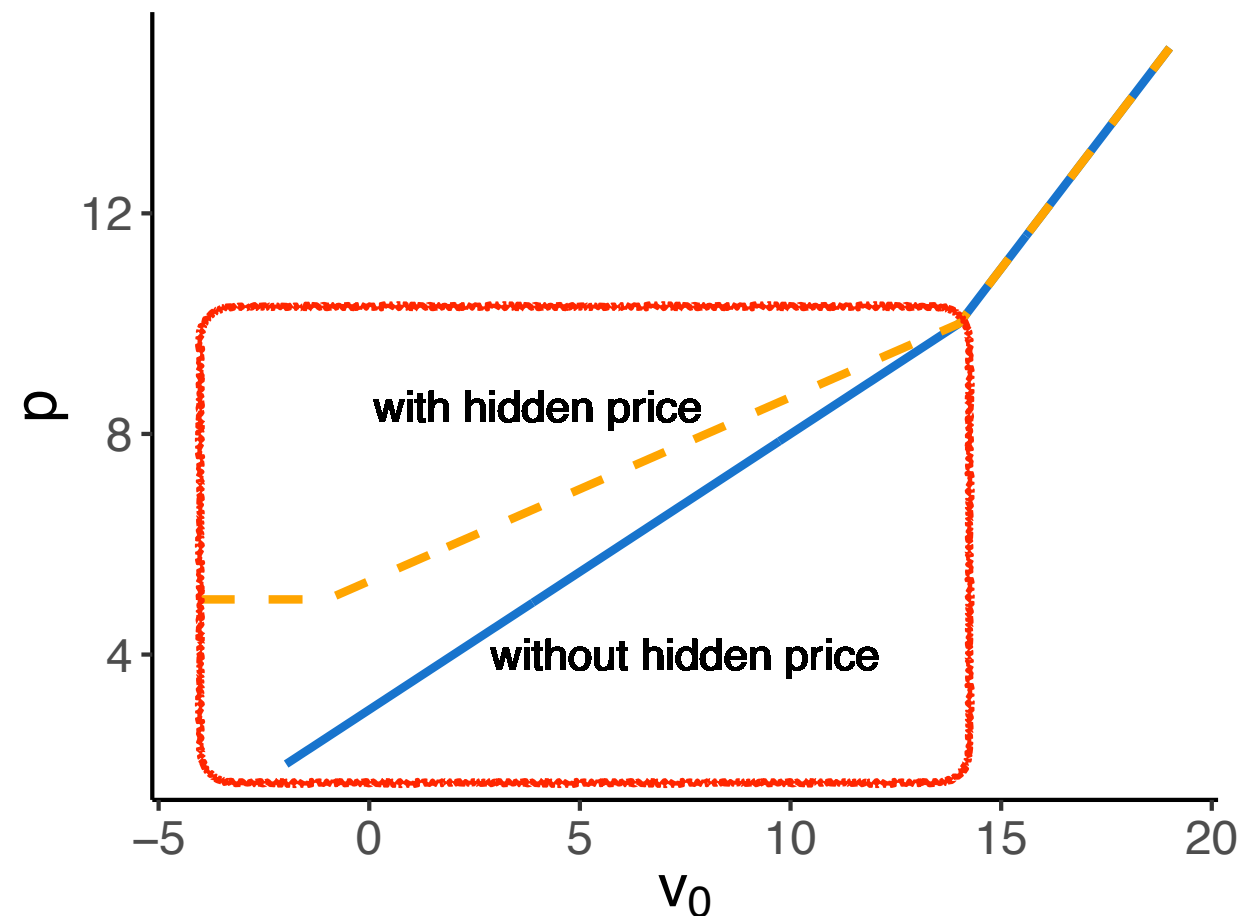
$$m = 2, \sigma = 0.4, c = 0.01$$

Strictly higher profit with a hidden price in the red area



$$m = 2, \sigma = 0.4, c = 0.01$$

Search behavior with and without hidden price



In the red area, the consumer's expected search time is strictly higher with a hidden price.

Heterogenous consumers

Heterogenous consumers

- Heterogenous learning speeds (this talk)
- Heterogenous Initial valuations

Heterogenous learning speeds

- Two groups of consumers with $\sigma \in \{\sigma^H, \sigma^L\}$, where $\sigma^H > \sigma^L$
- $Prob(\sigma = \sigma^H) = \rho_\sigma$
- Distribution of consumer types is common knowledge
- Realized type is each consumer's private information

Total price with hidden price may be lower than the price without hidden price

- Sufficient condition:

$$\rho_\sigma < \widehat{\rho}_\sigma,$$

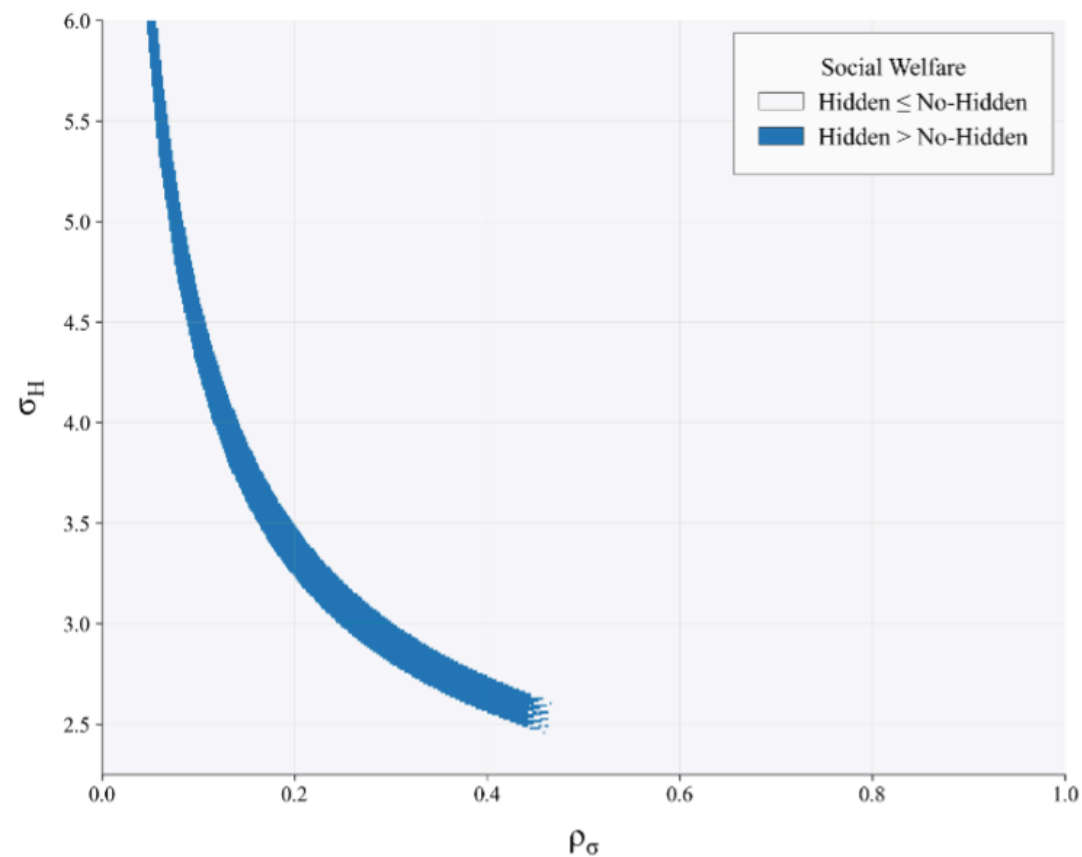
$$\sigma_H > \sqrt{3}\sigma_L,$$

$$\max\{-m/2, -\sigma_H^2/4c + m\} < v_0 < -3\sigma_L^2/4c + m,$$

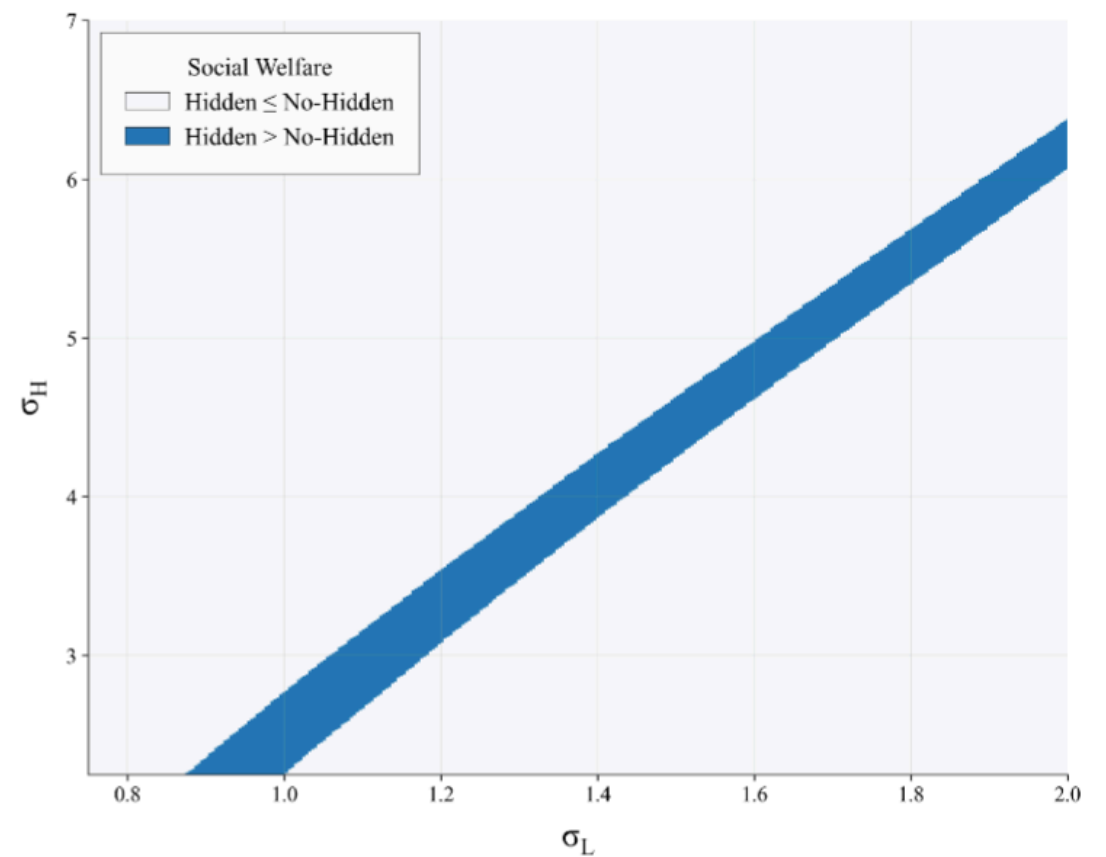
$$\sigma_L^2/2c < m$$

- Basic mechanism:
 - ▶ not profitable to sell to low-learning-speed consumers without hidden price
 - ▶ set the price optimal for high-earning-speed consumers (high price)
 - ▶ profitable to sell to both types of consumers with hidden price
 - ▶ lower price because the firm needs to expand the market
- Firm and high-learning-speed consumers better off with hidden price

The use of hidden price can even increase social welfare!



(a)



(b)

Thanks!